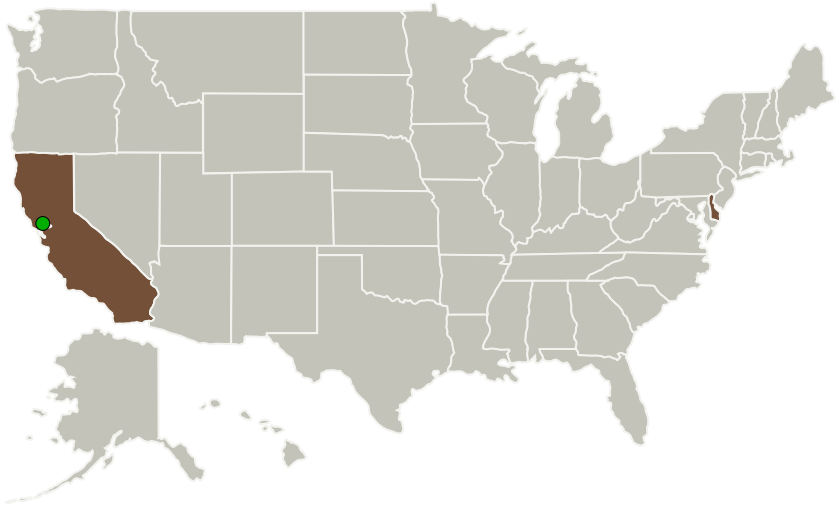
GPU-Accelerated Sparse Matrix Solvers for Large-Scale Simulations, Phase II

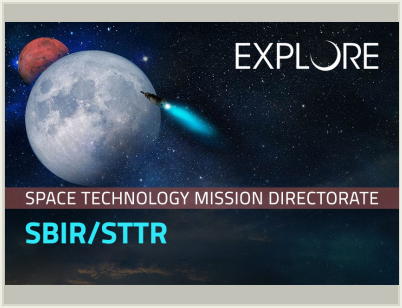
Completed Technology Project (2011 - 2013)

Project Introduction

At the heart of scientific computing and numerical analysis are linear algebra solvers. In scientific computing, the focus is on the partial differential equations (PDEs) that arise from computational fluid dynamics (CFD), climate modeling, astrophysics, and structural and heat analysis that cannot be solved analytically. Certain problem formulations lead to sparse matrices, in which the majority of matrix elements are zero. Special attention is required when computing on sparse matrices in order to avoid using unrealistic amounts of memory or produce ill-performing software. Such topics have been the subject of considerable research and the limits of CPU-based performance have been reached. Recently, the graphics processing unit (GPU) has emerged as an attractive platform for high performance computing. The modern GPU boasts over 1 TFLOPS performance and as much as 6 GB onboard memory, but harnessing the power can be challenging. A library-based approach is common for HPC, with most applications using several libraries to offload well-known tasks. EM Photonics maintains a library of GPU-accelerated dense linear algebra solvers that has over 5000 users. In this project we will extend this library to include a wide range of sparse solvers, including many that have direct relevance to NASA projects.

Primary U.S. Work Locations and Key Partners





GPU-Accelerated Sparse Matrix Solvers for Large-Scale Simulations, Phase II

Table of Contents

GPU-Accelerated Sparse Matrix Solvers for Large-Scale Simulations, Phase II

Completed Technology Project (2011 - 2013)

Organizations Performing Work	Role	Type	Location
EM Photonics, Inc.	Lead Organization	Industry	Newark, Delaware
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Delaware

Project Transitions

June 2011: Project Start

May 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138894)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

EM Photonics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

John R Humphrey

Co-Investigator:

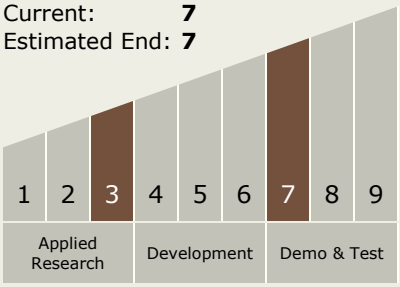
John Humphrey

GPU-Accelerated Sparse Matrix Solvers for Large-Scale Simulations, Phase II

Completed Technology Project (2011 - 2013)

Technology Maturity (TRL)

Start: **3**
Current: **7**
Estimated End: **7**



Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.3 Simulation
    - TX11.3.5 Exascale Simulation

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System